

### Remarks

The specification has been amended at pages 9, 10, and 11. Claims 2-5, 7 and 11 have been amended with details set forth in Attachment I (Version with Markings to Show Changes Made).

### Drawing Objections

Arrow 13 of Fig. 2 has been referenced on page 9 of the specification. Filters F1 and F2 of Fig. 4 have been referenced on pages 10 and 11 of the specification. In Fig. 3, the head of arrow "22" was omitted and will be added when formal drawings are submitted.

### Specification Objection

On page 9, line 24, "grading" has been changed to read – grating –.

### The 35 USC 112 Rejection

Claims 1-14, 16, 19 and 20 are rejected under 35 USC 112, second paragraph, as being indefinite.

The Examiner states that the definition of "N" is not clear. Attention is directed to page 2, lines 10-30 of Applicants' specification. "N" is usually considered to be a number of a component, such as 1, 2, 3, 4 ... N. No "N" does not equal "O". The objections to Claims 2-5, 7 and 11 have been overcome by amendment.

The term "the group consisting of" is widely recognized as a Markush grouping, and thus "the group" needs no antecedent. As to Claim 6, "identical" means "identical", what more can be said. Similarly "different" means "different" and one needs not spell out how the filter are different. See page 11, lines 20-21 of the

specification. When Claim 12 is read in light of its parent Claim 1, which "outputs" and "diffraction grating" is believed to be clearly understood. As to Claim 16, "intermediate wavelength density" means wavelength densities between "high" density and "low density". In Claim 19, "said means" refers to the "means" recited in the last line of parent Claim 16 and the full description of that "means" need not be set forth since it is the only "means" recited. It is clear what the "means" in Claim 19 is referring to.

#### The 35 USC 102 Rejections

Claims 1-3 and 5 are rejected under 35 USC 102(e) as anticipated by Suemura et al, Applicants are unable to find in this reference an "improvement" in "a wavelength router" which comprises the following:

"at least one diffraction grating which utilizes only N wavelengths to interconnect N inputs to N outlets in a fully non-blocking manner."

It is requested that if this rejection is maintained, the Examiner points out where in this reference the features of these claims are found. Thus, this rejection should be withdrawn.

Claims 16 and 17 are rejected under 35 USC 102(b) as anticipated by McMahon. Claim 16 sets forth "receiving a number of inputs and for discharging a greater number of outputs". As shown in Fig. 6, referenced by the Examiner, there are there inputs and three outputs. Thus, this rejection should be withdrawn.

Claims 16, 19 and 20 are rejected under 35 USC 102(e) as anticipated by Asghari. As shown in Figs. 2, 3 and 7, there is one input and one output and thus fails to teach the features of parent Claim 16. Therefore, this rejection should be withdrawn.

Allowable Subject Matter

It is noted that no prior art has been applied against Claims 4, 6-15 and 18, and Claims 15 and 18 were not rejected under 35 USC 112. Thus, these claims are deemed to be allowable.

Conclusion

In view of the amendments to the specification and claims, and the foregoing comments, it is believed that each objection and rejection has been overcome. Thus, this application is believed to be allowable based on Claims 1-20.

Respectfully submitted,

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Enclosure:  
Attachment I

Attachment I  
S.N. 09/609,178  
Version with Markings to Show Changes Made

In The Specification:

The paragraph of page 9, lines 4-15, has been amended as follows:

The embodiment of Figure 2 comprises a collection and re-direction optic assembly CRD, a pair of diffraction gratings G1 and G2, and a retroreflector assembly RR (which can veritically displace and retro-reflect n-1 beams). The CRD functions to collect and re-direct the n-1 beams from the RR back through the gratings G1 and G2. As shown in Figure 2, inputs 1, 2, and 3 are incident onto gratings G1 and G2 producing outputs 1', 2', and 3', shown by arrow 13 as combined outputs, and complimentary outputs 1\* and 2\*, as indicated by the arrows. Outputs 1\* and 2\* are reflected by the RR back through gratings G1 and G2 to the CRD, as shown by the double arrows, and are redirected by the CRD, as indicated at 11 and 12 onto gratings G1 and G2. The CRD is placed such that the optical beams are properly routed back through the gratings G1 and G2 onto the outputs 1' and 2' to complete the routing of all output channels.

The paragraph bridging page 9, line 19 to line 2, page 10, amend to read as follows:

The embodiment of Figure 3 comprises an input optic 16, identical diffraction gratings G1 and G2, collection optic assembly 17, and two wavelength-selective add/drop (3-port) filter modules M1 and M2, with the filters of each module being different. Inputs 1, 2, and 3 are directed as indicated by arrow 18 through optic 16

onto grating G1 and to grating G2 with outputs from grating [grading] G2 indicated at 1', 2', 3', 1\*, and 2\* and which are directed through collecting optic assembly 17 whereafter outputs 1'' and 1\* are directed into M2 having an output 19, outputs 2'' and 2\* are directed into M1 having an output 20, and output 3'' becomes output 21 as indicated by arrow 22. For N channels, N-1 different filters are required for NxN fully non-blocking interconnection.

The paragraph bridging page 10, line 14 to line 24 of page 11, amend to read as follows:

Figure 4 schematically illustrates the coarse WDM grating router experimental setup. Initial experimental results using 3 inputs and 3 outputs are hereinafter described. In Figure 4, the inputs A, B, and C are mapped to outputs 1, 2, 3, 1\*, and 2\*, which are subsequently combined with add/drop filters F1 and F2 to produce the final 3 outputs X, Y, and Z. Wavelength routing was demonstrated using 3 wavelength channels: 827, 864, and 99 nm. Graded index (GRIN) 62.5/125  $\mu\text{m}$  MMF inputs and outputs were terminated in an MT ferrule to provide a fiber to fiber pitch of 250  $\mu\text{m}$ . Three fibers were illuminated with white light from a tungsten lamp. A lens was used to collimate the incident light from the inputs and focus the diffracted light from the grating. Based on the fiber pitch and spectral channel spacing, a linear dispersion of  $\Delta x / \Delta \lambda = 250 / 35 = 7.143 \mu\text{m} / \text{nm}$  was required in the focal plane of the lens. The linear dispersion of a lens and grating combination used in the Littrow configuration is given by:  $\Delta x / \Delta \lambda = 2f \tan(\theta) / \lambda$  Where  $f$  is the focal length of the lens, and  $\theta$  is the blaze angle of the grating. This

equation is valid for wavelengths near the blaze wavelength. The diffraction grating used in this demonstration had a groove density of 400 lines/mm, blaze angle of 9.962 degrees (blaze wavelength = 845 nm for Littrow mounting), and was gold coated for high reflectivity. Based on the grating parameters, a lens with a focal length of 16mm was used to expand and focus the light to and from the fibers. By matching the linear dispersion of the lens and grating combination to the fiber pitch and spectral channel spacing, adjacent spectral channels from a single input are focused to adjacent output fibers. For example, input A, sends  $\lambda = 830, 865$ , and 900 nm to outputs 1, 2, and 3 respectively. Furthermore, by spacing the input fibers with the same pitch as the outputs, adjacent inputs send adjacent spectral channels to the same output. Thus, output 3 receives  $\lambda = 900, 865$ , and 830 nm from inputs A, B, and C respectively. For this device, in general, N inputs produce 2N-1 outputs, one of which has all N wavelengths properly routed and the rest of the outputs forming N-1 pairs of complimentary beams. For example, output 1 only received  $\lambda = 830$  nm, while output 1\* receives  $\lambda = 865$  and 900 nm. By combining these pairs of complimentary beams, the full routing function is accomplished. Although 2x1 couplers could be used to combine the beam pairs, it is well known that this type of beam combining incurs a 3dB penalty. In order to circumvent this penalty, we used two add/drop filters F1 and F2 with different passbands to re-combine the two pairs of complimentary output beams. In this application, two inputs are multiplexed onto a single output, one input being reflected by the filter and the other being transmitted through the filter.

In The Claims:

Amend Claims 2-5, 7 and 11 as follows:

2. (Amended) The improvement of Claim 1, wherein said diffraction grating is augmented by elements selected from the group consisting of coupler and wavelength selective elements to provide fully non-blocking interconnection.

3. (Amended) The improvement of Claim 2 [1], wherein said coupler is selected from the group consisting of directional couplers and wavelength-selective couplers.

4. (Amended) The improvement of Claim 3, wherein said coupler comprises a wavelength-selective coupler which comprises an optical wavelength add-drop multiplexer.

*add to  
Cl. 1 and  
cancel*

5. (Amended) The improvement of Claim 1, additionally including a second [another] diffraction grating position to receive outputs from said first mentioned diffraction grating.

7. (Amended) The improvement of 6, additionally including a collection optic assembly positioned to receive outputs from said [another] second diffraction grating, and a plurality of filter modules positioned to receive outputs from said collection optic assembly.

11. (Amended) The improvement of Claim 5, additionally including at least one collection and re-direction optic assembly position to direct inputs to said first-mentioned diffraction grating, and a retro-reflector assembly position to receive outputs

from said second [another] diffraction grating and reflect certain of said outputs back through said diffraction grating.